WHY YOU CHANGE GEARS ON HILL

Expert Explains Why You Should Give Engine a Fair Chance.

By H. CLIFFORD BROKAW.

Perhaps you have wondered why it was necessary to change speed gears on a hill. It may be you have thought it a useless custom and have tried to take the hills on high, regardless of what it does to your motor. If so, pause long enough to learn the why of speed gears on the car and the reason why second, or even first, speed is necessary in hill climbing. It may save you fuel and upkeep charges.

If automobiles were driven entirely on smooth and level roads at an even speed there would be no need of a gear case; all that would be needed would be a clutch to connect and disconnect the engine from the road wheels. No other device would be needed to meet the conditions of smooth, straight roads, where speed is possible and desirable; but for sandy roads or steep hills if there were no change speed gears it would be necessary to have a very high power engine under the hood and the maximum of such power would only be used at rare intervals. At all other times the motor would be very wasteful in operation.

A gasolene engine does not operate efficiently at low speed; to get economical power it must be run at comparatively high speed. On a heavy grade or a sandy road it is not speed but power that is needed and if the engine does not develop it under the slowed down conditions of the grade or heavy road it follows that the motor must be speeded up and run at high speed. The only way to accomplish this is to introduce a device which will permit the engine to run at normally high speed to develop the power and to transmit this power to the road wheels at a lower speed. This device is called the transmission gearset.

This gearset is merely an arrangement of gears on parallel shafts which permits a selective meshing at varying ratios, so that without decreasing the engine speed a lower speed is transmitted to the drive shaft. Most persons are familiar with the principle of reducing speed by gears in machinery. The gearset usually is arranged for three speeds, low, intermediate and high forward, as well as reverse. The high speed gear is known also as the direct drive, which means that the propeller shaft, leading from the transmission case to the rear axle, is directly connected to the engine shaft and makes the same number of revolutions.

The intermediate speed gear will probably give about two revolutions of the motor shaft to one of the propeller shaft, while the low speed ratio is three or three and one-half to one. The reverse gear is usually a trifle slower, or about four to one. These figures will vary in different cars, but are approximately correct.

Besides the transmission gear reduction there is a reduction at the rear axle, through the differential gears, ranging from 3—1 to 5—1, with the usual figure not far from 4½—1; that is, the propeller shaft makes four and one-half revolutions to each one revolution of axle and road wheels.

Probably it will give some idea of how the power is increased by changing to a lower speed if we take as an example a car with a four cylinder engine, with wheels equipped with 34 inch tires and with a reduction at the rear axle of 4½ to 1. With 34 inch tires the car will travel forward approximately nine feet with each revolution. If the car is being driven on high speed gear, for each nine feet of travel on the ground the engine shaft will make four and one-half revolutions, and as there are two power impulses to each shaft revolution of a four cylinder engine, there will be nine power impulses, or one per foot.

Changing to the intermediate speed gear and assuming that its reduction is 1.8 to 1, in addition to the 4½ reduction at the differential, a total of 8—1, there will be sixteen power impulses for each nine feet of travel, or nearly two per foot. This should make it clear that by shifting the gears and increasing the number of power impulses we have nearly doubled the pulling force exerted.

On the low speed gear, with a reduction ratio of 3.2 and the 4½ reduction of the rear axle, a total ratio of 14½ to 1 is obtained, which gives 29 power impulses for each 9 feet, or more than 3 per foot.

With a 12 cylinder motor there are six power impulses for each revolution of the crank shaft, and with 36 inch tires there would be approximately 9½ feet of travel per revolution. With a 4½ ratio on the differential, on high speed gear we would get 27 power impulses for 9½ feet of travel, or about 3 per foot; on intermediate speed gear there would be 48 power impulses, or 5 per foot, and on low speed gear 97 power impulses or 10 per foot. This does not necessarily mean that a 12 cylinder motor is more powerful than a 4 cylinder; that depends on other things, and the 12 explosions might develop much less power than the four. But the comparative pulling power of the several gears is the same, no matter how many cylinders there are.

It should be plain from this that in climbing a hill where the grade is so steep that the motor cannot make it on high speed gear with one power impulse per foot of travel, it is possible to change to intermediate and procure two power impulses, or to low speed and get three.

Grades usually are overestimated. We often hear persons speak of 30 per cent. grade, when it is doubtful if they ever have seen a road with that grade—15 per cent. seems to be about the limit hereabout. The reason for overestimating hills is that in looking up a grade the distance appears to be much less than it is really; we seem to see a great rise in a short distance and of course conceive of a steep grade. If the eye properly judged distance with height we would know that perhaps it was but a gentle slope.

When going down one grade and about to start up another, invariably the one ahead seems to be very steep, because here we have even a greater angle of observation. It is like estimating the height of waves at sea. The unaccustomed eye, when the ship's bow goes over the crest of a wave, sees the mast tops apparently on a level with the next wave, and at once calls the wave 100 feet high, because it is compared with the height of the mast. The angle of the mast was wholly neglected.

Sometimes when touring the motor appears to be pulling finely on an apparently steep hill, while at other times the opposite is true and the motor labors on what we think a slight rise. The reason lies in wrong estimate in each case. The eye has led us to jump at a conclusion by observing the grade at a wrong angle.

To test out my eye as to grades I have been measuring some of them recently, with the following result:

West Drive in Central Park, just below 110th street, going north, 4½ per cent.; going south, 5½ per cent.

Viaduct on 155th street, west of Central Bridge, is 5½ per cent., while the slight hill at the west end of the viaduct is 10 per cent.

The well known Fort George hill, the scene of so many hill climbing tests, is about 12 per cent.

Probably one of the steepest hills in the city is a little stretch of 187th street from Broadway to Wadsworth avenue, where the grade is 15 per cent.

In figuring the percentage of a grade it should be remembered that 100 feet rise in 100 feet horizontal distance gives an angle of 45 degrees, but it is a 100 per cent. grade.

While we are likely to overestimate grades, care should be had that we do not overestimate the pulling power of the engine on grades. One should learn to shift gears handily and then give the engine a chance. It will tend for longer life for the power plant, and the minute or so longer spent on the hill will not make much difference in time of reaching our destination.

"Listen, Lester"—Here Is "Some Car."

Harry L. Cort, co-author with George E. Stoddard of the musical show "Listen, Lester," is shown here with two of his friends, giving the reader some idea of the room there is in his latest Premier.

SPECIAL SHOWING OF FIATS.

Morton W. Smith Company have been fortunate in obtaining a limited number of the well known Fiat cars. Latest touring models for immediate delivery are now on exhibition at their salesrooms, 19 West Forty-fourth street.

JOHN N. WILLYS WILL INCREASE OUTPUT

Outlines Big Plans in Annual Report and Predicts Record Demand.

In his annual report to the stockholders John N. Willys, president of the Willys Overland Company, announces a new manufacturing plan which calls for a production expansion in Toledo to 175,000 cars during 1919. This will mean an increase of 25 per cent. over the company's best year.

"In proportion to the supply the demand for cars," Mr. Willy says, "was probably never greater than to-day. The outlook for the farm and tractor industries was never brighter."

Mr. Willys's report is an impressive disclosure of the strength and the flexibility of the Willys Overland plant and organization. The 1918 business was 10 per cent. greater than in 1917, the best previous year in the company's history. While the gross profits for 1918 totalled $11,516,645, necessary deductions for reserves for depreciation, replacement of tools, equipment, &c., and obsolete parts and materials leave a net income for the year of $5,536,254. This showing is considered excellent in view of the radical factory adjustments from a peace to an 80 per cent. war basis and an equally radical readjustment after armistice to a peace basis.

All passenger car production ceased on November 1, 1918. On the day that the armistice was signed the company had on hand $75,000,000 of Government business, of which 42 per cent. was completed. The company had determined to shape its 1918 programme to the winning of the war and a wide variety of Government contracts was accepted. In the production of gun carriages alone the Toledo plant reached a daily production greater than the combined gun carriage works in France. By December 31 the company would have been on a 100 per cent. war basis.

"By January 2," Mr. Willys reports, "or within less than fifty days after the stop work instructions on war contracts, we were again turning out automobiles, and by January 31 were shipping 315 cars daily. At the present time 425 cars being turned out daily in accordance with a schedule calling for a steady increase to 1,000 cars daily in August."

In September, 1918, the Willys Overland Company acquired control of the Moline Plow Company. The output there in agricultural implements and farm tractors will be doubled and in 1920 doubled again. The purchase was made, Mr. Willys writes, because the Willys Overland Company anticipated, regardless of war or peace, "an almost unlimited demand for tractors in an age of power farming."